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OCCURRENCE, DISTRIBUTION AND CONTROL OF MAJOR INSECT PESTS OF SOME IMPORTANT CROPS IN MYSORE

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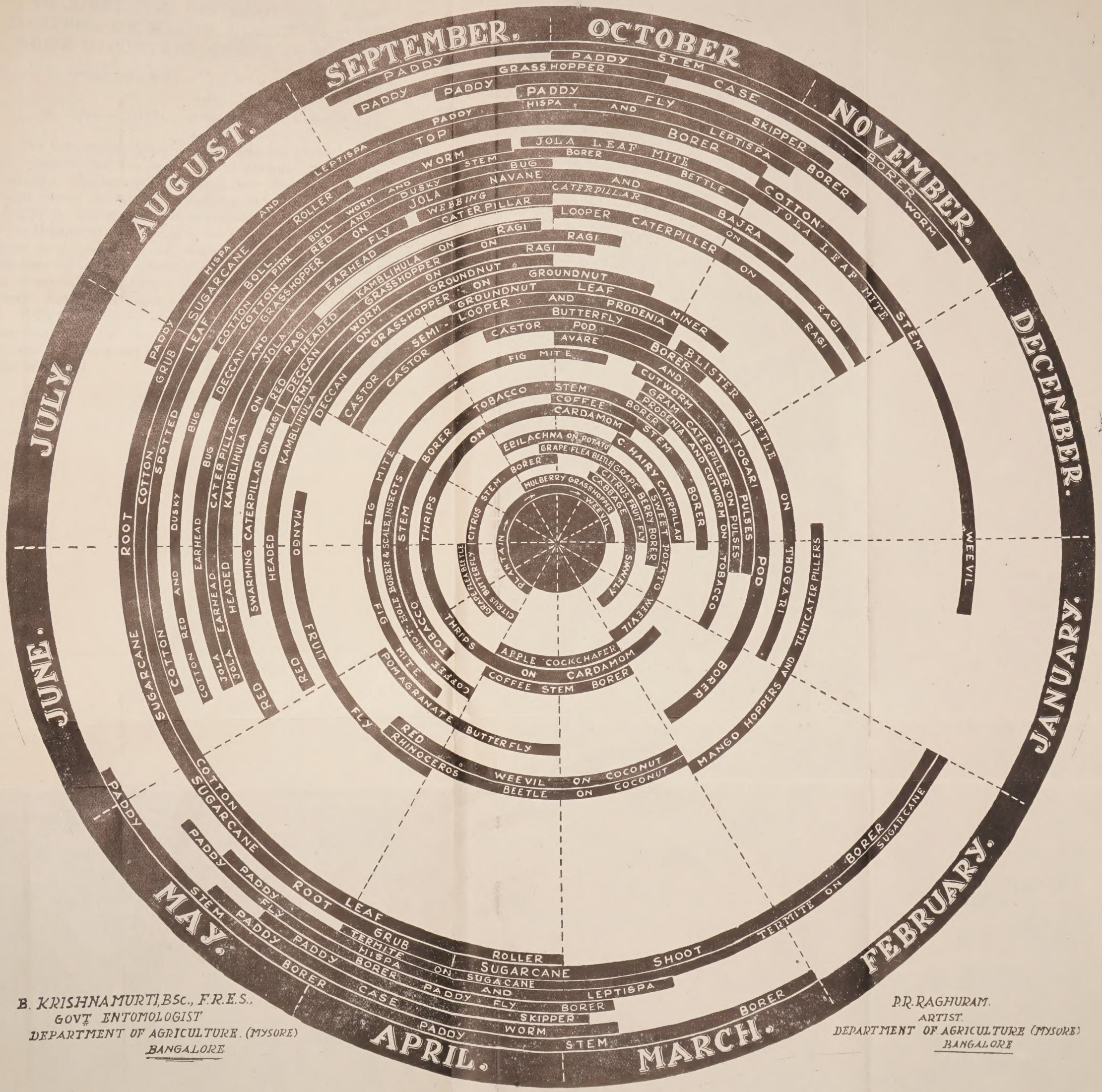
SEASON CHART OF INSECT PESTS OF SOME IMPORTANT CROPS IN MYSORE



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This chart shows at a glance the seasonal occurrence of various major insect pests of different important crops. The period of occurrence of each of the pests dealt with is indicated in the form of a black 'duration arc-band' which covers the months in which the pest occurs. In addition, the chart indicates, by means of the radial lines, the several pests of different crops that are commonly met with during a particular month. But it should be understood that all the pests do not occur throughout the State and that some are specific to particular areas. The chart does not, however, indicate the occurrence of certain pests peculiar to some crops which are grown in more than one season under the 'Grow More Food' Scheme.

OCCURRENCE, DISTRIBUTION AND CONTROL OF MAJOR INSECT PESTS OF SOME IMPORTANT CROPS IN MYSORE

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AND

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The fight against insect pests of crops has become more urgent and important than ever at the present juncture. Information about occurrence, distribution and control, that lies scattered about in annual reports and pamphlets, bulletins and scientific journals, published by the authors and their co-workers in the Entomology Section of the Department of Agriculture, has been brought together and presented as a consolidated list, which includes up-to-date knowledge based on the latest observations made. This list should serve as a ready and valuable reference to the practical agriculturist and the District Agricultural Officers and their staff.

With the cultivation of certain crops in more than one season in accordance with the "Grow More Food" Schemes, variations in the seasonal occurrence and distribution of certain pests peculiar to them may be noticed.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Paddy (*Oryza sativa*)	Stem borer (*Schoenobius incertellus*, W.)	Sept. to Nov. Mar. to June	All over the State	Caterpillar bores into central shoot, causing 'dead-hearts' in young seedlings and chaffy earheads in the mature plants	Steep seedlings in Guesarol 550 (1 lb. in 16 gallons of water) for ½ hour and allow the water to evaporate prior to transplantation; practise clean cultivation and cultural operations to remove grasses and weeds; remove and destroy eggmasses, moths and plants showing 'dead-hearts' by mechanical method—hand-picking; set up light-traps in the field to attract moths.
	Case-worm (*Nymphula depunctalis*, Gr.)	Sept. to Nov. Apr. to May	All over the State	Caterpillar cuts blades into pieces and makes 'cases' in which it lives and feeds on foliage. Damage is popularly called 'Kokre-Roga'	Flood the field and have a thin film of kerosine oil on the surface of water and dislodge caterpillars by a rope on to water; dust benzenehexachloride product (Gammexane D. 025) on to seedlings in clear weather.
	Grasshopper (*Heiroglyphus banian*, F.)	Sept. to Nov.	Shimoga Tumkur Hassan Mysore Bangalore Mandya Kolar Chikmagalur	Adults and nymphs feed on foliage and cut earheads	Scrape bunds in summer to destroy eggmasses; dust Gammexane D. 025, or Hexyclan (5 to 7 per cent.) or Hexidol (5 per cent.) on bunds and fields where pest is seen.

	Gall-Fly (*Pachydiplosis oryzae*, W.)	Oct. to Nov. Apr. to May	Shimoga Mysore	Maggot bores into stem and forms a 'Gall'; the central shoot is hollowed and glistens; earheads are not formed. Damage is popularly called 'Kolave-Roga'	Set up light-trap to attract adults; treat plot with a layer for 'Case-worm'; dust Gammexane cover the basal portions and suffocate the borer; remove infested seedlings and destroy them.
	Thrips (*Thrips oryzae*, W.)	June to July Feb. to Mar.	Mysore Mandya Bangalore Chikmagalur Kolar Shimoga Tumkur	Adults and nymphs lacerate the leaf-tissue and roll the leaf-blade in young seedlings thus causing it to dry	Prune the top of seedlings and destroy; flood the field with water; spray tobacco decoction; dust Gammexane D. 025 or tobacco powder.
Paddy (*Oryza sativa*)	Green Beetle (*Leptispa pygmoea*, B.)	Mar. to May July to Oct.	Shimoga Chikmagalur Mandya Hassan	Mostly grubs lacerate the leaf-tissue and cause the seedlings to wilt	Adopt Kerosine-oil treatment as for 'Case-worm'; dust Gammexane D. 025, or Hexyclan or Hexidol in clear weather; clip the top of seedlings prior to transplantation.
	Swarming Caterpillar (*Spodoptera mauritia*, B.)	Oct. to Dec.	Tumkur Kolar Bangalore Mandya	Caterpillar feeds on the foliage; nocturnal in habit	Collect caterpillars in the field and destroy them; flood the field with water with a thin film of kerosine oil in the evening.
	Skipper (*Parnara mathias*, F.)	Sept. to Nov.	Tumkur Mandya Bangalore Mysore	Caterpillar feeds on the foliage	Same control measures as for Case-worm.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Paddy (*Oryza sativa*)	Bug (*Leptocorisa acuta*, T.)	Nov. to Dec.	Tumkur Mandya Bangalore Mysore	Adults and nymphs feed on tender ear-heads	Dust Gammexane D. 025 on to infested earheads; collect bugs by sweeping handnets across the crop.
Ragi (*Eleusine corocana*)	Pink Stem Borer (*Sesamia inferens*, W.)	Feb. to Mar. Aug. to Oct.	Mysore Mandya Bangalore Tumkur Hassan Chitaldrug Kolar	Caterpillar bores into stem and causes 'dead-heart'	Earth up 20 to 30 days old young crop (Kar-Ragi) and repeat process after 15 to 20 days; uproot and burn all infested plants showing 'dead-hearts'.
	Cutworm (*Laphygma exigua*, H.) (*Euxoa segetum*, S.)	Sept. to Oct.	Mysore Chitaldrug	Caterpillar cuts stem above ground-level causing the plant to wilt.	Disperse poison-bait in the infested fields late in the evening.
	Black-headed Caterpillar (*Diacrisia obliqua*, W.)	Oct. to Jan.	Bangalore Hassan Tumkur Mandya Mysore	Caterpillars eat the foliage	Hand-pick and destroy egg-masses, young caterpillars on leaves, etc.; trench around the infested field and trap the migrating caterpillars on green leaves put into the trench. Collect fungus-infested caterpillars and distribute in infested fields.
	Red-headed Caterpillar	May to Aug.	Shimoga Chitaldrug	Caterpillars eat the foliage	Same control measures as adopted for Black-headed caterpillar; collect adult moths during

	(*Amsacta albistriga*, W.)		Kolar Tumkur		mornings and evenings. Set up light-trap during dark nights.
	Aphis (*Aphis maidis*, F.)	May to Aug	Bangalore Mysore Chitaldrug Kolar	Adults and nymphs suck the sap from leaf blades and cause wilting of plants (Kar-Ragi)	Dust plants with finely powdered tobacco mixed with equal parts of soap; uproot and burn badly-infested plants.
	Armyworm (*Cirphis unipuncta*, H.)	Oct. to Nov.	Mandya Tumkur Bangalore	Caterpillar feeds on the foliage and bores into tender central shoot	Collect the caterpillars and pupæ and destroy them; dust Gammexane D. 025 (1 lb. in 6 lbs. of woodash).
	Earhead Caterpillar (*Stenachroia elongella*, H. and other Sp.)	Sept. to Nov.	Mysore Mandya Bangalore Hassan	Caterpillars feed on grains and convert them into power and web.	Dust earheads in the field with Gammexane D. 025 or Hexyclan or Hexidol 5%; dust harvested stalks with earheads with any of the above chemicals before stacking; fumigate (with 'Killoptera') stacks which are heavily infested under tarpaulins.
Jola (*Andropogon sorghum*)	Deccan Grasshopper (*Colemania sphenarioides*, B.)	July to Nov.	Shimoga Chitaldrug	Adults and nymphs feed on leaves and tender earheads	Dust bund in July-August with a mixture of Sodiumsilicofluoride and woodash (1 : 3) or Gammexane D. 025 or Hexyclan or Hexidol (5 to 7%); collect Hoppers in large-sized bags and destroy them; disperse poison-bait (Sodiumsilicofluoride + wheatbran + molasses) in the evenings.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Jola (*Andropogon sorghum*)	Earhead Bug (*Calocoris angustatus*, L.) Earhead Fly (*Contarinia andropogonis*, F.)	June to Sept.	Mysore Mandya Hassan Tumkur	Adults and nymphs suck sap from tender earheads and make them chaffy	Dust earheads with a mixture of equal parts of fine tobacco powder and soap powder or with Gammexane D. 025 and chalk powder (1 : 6); dusting to be repeated if necessary.
	Earhead Webbing Caterpillar (*Stenachroia elongella*, H.)	June to Sept.	Mysore Mandya Hassan Tumkur	Caterpillars feed on grains and convert them into powder and web. Damage is popularly called 'Gud-maru'	Dust earheads with Gammexane D. 025 and woodash (1 : 4) or Hexyclan (5%); thresh grains early after drying.
	Stem Borer (*Chilo zonellus*, S.)	May to July	Mysore Shimoga Chitaldrug Tumkur Mandya Kolar	Caterpillars bore into the stem and cause 'dead-heart' in young crop	Uproot and burn all plants showing 'dead-hearts'. Light-earth-up young seedlings.
	Leaf Mite (*Paratetranychus indicus*, H.)	Sept. to Nov.	Mysore Chitaldrug	Adults and young ones lacerate the leaf tissue causing the colour of the leaf turn red and gradually dry up. Damage popularly called 'Kumkum Roga'	Dust the infested crop with a mixture of sulphur and woodash (1 : 6) as soon as red blotches are seen; remove and destroy old and heavily-infested leaves.

	Fly Stem Borer (*Antherigona indica*, M.)	May to June	Mysore Mandya Bangalore	Maggot bores into central shoot of seedling and causes 'dead-heart'	Remove seedlings which are wilting and which show 'dead-hearts'; seed rate may be increased to compensate any loss due to this insect attack.
Sugarcane (*Saccharum officinarum*)	Shoot Borer (*Argyria sticticraspis*, H.)	Feb. to Apr.	All over the State	Caterpillar bores into young canes and causes 'dead-hearts'	Plant 'borer-free' setts; earth up young cane (2 to 4 weeks old); dust seedlings of same age with D.D.T. 5%; remove infested seedlings; liberate egg-parasites (*Trichogramma minutum*, R.) in young cane fields.
	Top Borer (*Scirpophaga nivella*, W.)	Aug. to Oct.	All over the State	Caterpillar bores into stem from top-shoot causing 'bunchy top'	Dust D.D.T. 5% or Gammexane D. 025 (5%) when cane is 3 months old; collect moths and destroy; collect eggmasses on leaf blades and liberate egg-parasites emerging from egg-masses collected in the field back into the field.
	Termite (*Odontotermes obesus*, R.)	Feb. to Apr.	Mandya	Attacks planted setts and destroys them	Steep planting-setts in lime solution with calcium or lead arsenate in it, allow to dry and plant; destroy termite nests in the neighbourhood; flood fields with termite attack more frequently than others.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
	Root Grub	Apr. to July	Mandya	Grub attacks setts and roots inside the soil.	Set up light-trap soon after showers in summer to attract the adult beetles and destroy them; put naphthalene or paradichlorobenzene at a depth of 2 to 4 inches around cane clumps.
Avare (*Dolichos lab-lab*)	Pod Borer (*Adisura atkinsoni*, M.)	Oct. to Jan.	Mysore Bangalore Mandya Kolar Hassan Tumkur	Caterpillar bores into tender and mature pods and damages the seeds within	Destroy the white round eggs by hand-squeezing; dust young pods and spikes with D.D.T. 5% or Gammexane D. 025 mixed with 6 parts of woodash once a fortnight.
	Plume Moth (*Sphenarches caffer*, Z.)	Oct. to Jan.	Mysore Bangalore Mandya Kolar Hassan Tumkur	Caterpillar bores into flower buds and tender pods	Dust blossoming flower buds spitted with D.D.T. 5% or Gammexane D. 025 mixed with 6 parts of woodash once a fortnight.
Red Gram (*Cajanus indicus*)	Leaf-Eating & Pod Borer Caterpillar (*Heliothes obsoleta*, R.)	Oct. to Dec.	Bangalore Kolar Tumkur Mysore	Caterpillar eats leaves and bores into pods.	Spray young crop with calcium arsenate; or dust infested crop with D.D.T. 5% or Gammexane D. 025.
	Blister Beetle (*Mylabris pustulata*, Thub.)	Nov. to Jan.	Bangalore Kolar Tumkur Mysore	Beetles feed on flowers and damage them.	Collect beetles with hand-net and destroy; dust D.D.T. 5% or Gammexane D. 025.

	Plume Moth (*Exelastes atomosa*, W.)	Nov. to Dec.	Bangalore Kolar Tumkur Mysore	Caterpillar bores into tender pods and damages the seeds within.	Dust crop with D.D.T. 5% or Gammexane D. 025.
Potato (*Solanum tuberosum*)	Epilachna Beetle (*Epilachna-viginti-octo-punctata*, F.) "Handi Hula" or 'Gulaganji Hula'	Aug. to Oct. Jan. to Feb.	Bangalore Kolar	Adults and nymphs feed on leaves.	Spray plants (3 to 4 weeks old and later 8 weeks old) with calcium arsenate solution; collect parasitised grubs and liberate emerging parasites into fields having infestation.
	Tuber Moth (*Phthorimoea operculella*, Z.)	Nov. to Jan. Apr. to June	Bangalore Kolar and other areas where potato is stored	Caterpillar bores into the tubers mostly after storage.	Cover the stored tubers with a layer of sand (1½" thick); remove and destroy infested tubers; dust tubers for seed purposes only with D.D.T. 5 % or Gammexane D. 025 in godowns.
Cucumber & Gourds (*Cucurbitaceae*)	Fruit Fly (*Dacus correctus*, B.; *Dacus cucurbitae*, C.; and *Dacus ciliatus*, Lw.)		Bangalore Mysore Tumkur	Maggots bore into the fruits and cause rotting of fruits	Spray foliage and just-set fruits with a bait-spray (1 part calcium arsenate + 4 parts sugar + 20 gallons water); rake soil round plants to expose maggots and pupæ; dress soil round plants with D.D.T. 5% or paradichlorobenzene; attract adult flies to traps with attractants (Citronella oil, etc.).

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Sweet Potato (*Ipomoea batatus*)	Weevil (*Cylas formicarius*, F.)	Dec. to Feb.	Chitaldrug Tumkur Kolar	Adults and grubs bore into the tuber both in field and in store	Cover the exposed tubers with soil in the field; dust foliage before tubers form with D.D.T. 5% or Gammexane D. 025; cover tubers in store with 1" thick layer of sand.
Onions (*Allium cepa*)	Thrips (*Thrips tabaci*)	April to May Dec. to Jan.	Chitaldrug Kolar	Adults and nymphs lacerate the leaf tissue	Dust mixture of tobacco powder and woodash (1 : 4), or Gammexane D. 025 and woodash (1 : 4) or D.D.T. 5% and woodash (1 : 4); spray fishoil resin soap (1 lb. in 8 gallons of water) or tobacco decoction (1 lb. + 1½ gallons of water + 1/8 lb. soap), or calcium arsenate when the seedlings are young.
Chillies (*Capsicum*, sp.)	Thrips (*Scirtothrips dorsalis*, H.)	July to Aug.	Chitaldrug Kolar	Adults and nymphs lacerate the leaf tissue	Same control measures as for Thrips on Onion.
Cabbage	Leaf-Eating Caterpillars (*Crocidolomia binotalis*, Z.; *Plutella maculipennis*, C.; *Athalia proxima*, K.; and	Nov. to Feb.	Bangalore Kolar Tumkur	Caterpillars eat the leaves	Spray D.D.T. 550 (Guesarol) 1 lb. in 16 gallons of water, before the bulbs are formed.

	Prodenia litura, F.)				
	Aphis (*Myzus persicae*, S.)	Nov. to Feb.	Bangalore Kolar Tumkur	Adults and nymphs damage the crop by sucking sap	Spray tobacco decoction with soap added, or Hongey-oil soap or fish oil resin soap (1 lb. in 10 gallons of water).
Mango (*Mangifera indica*)	Hoppers (*Idiocerus*, sps.)	Jan. to May	Bangalore Kolar Tumkur Mysore Shimoga Chikmagalur	Adults and nymphs suck the sap from flower buds and blossoms and prevent setting of fruit	Spray flower buds and blossoms with hongey oil or fish oil soap (1 lb. in 8 gallons of water) or D.D.T. (Guesarol) 550-50% or DeDeTane 20% (1 lb. in 20 gallons of water).
	Scale Insects & Mealy Bugs	Jan. to May	Bangalore Kolar Tumkur Mysore Shimoga Chikmagalur	Insects suck the sap from leaves and tender shoots	Same control measures as for Hoppers.
	Tent Caterpillars	Dec. to Feb.	Bangalore Kolar Tumkur Mysore Shimoga Chikmagalur	Caterpillars eat the leaves and web	Hand-pick all caterpillars, pupæ and webbed-leaves and destroy the same.
	Fruitfly (*Dacus dorsalis*, H.)	May to June	Bangalore Kolar Tumkur Mysore Shimoga Chikmagalur	Grubs bore into the fruits and damage them	Attract flies to poison-baits; rake soil beneath the trees and expose pupæ.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Guava (*Psidium guyava*)	Fruitfly (*Dacus dorsalis*, H.)	Sept. to Nov.	Bangalore Tumkur Kolar Mysore	Grubs bore into the fruits and damage them	Same control measures as for Mango Fruitfly.
Plantain (*Musa sapientium*)	Weevil (*Cosmopolites sordidus*, G.)	May to Dec.	Mysore Hassan Bangalore Mandya	Grubs bore into rhizomes and cause rotting	Uproot and destroy infested rhizomes.
Citrus	Butterfly (*Papilio demoleus*, L.)	May to June	Hassan Chikmagalur Bangalore Tumkur Mysore Mandya	Caterpillars defoliate the plants	Spray calcium arsenate solution before fruit formation.
	Stem Borer (*Chelidonium cinctum*, G.)	June to Aug.	Hassan Chikmagalur Bangalore Tumkur Mysore Mandya	Grubs bore into tender twigs and main stem and cause drying up	Prune the infested twigs about an inch and a half away from the hole towards centre and destroy; block all holes (except one) through which white powder comes out with moist red-earth and inject 50% phenyle.
	Scales and Mealy Bugs	July to Sept.	Hassan Chikmagalur Bangalore Tumkur Mysore Mandya	Insects suck the sap out of tender shoots and leaves	Spray D.D.T. (Guesarol) 550 (1 lb. in 12 gallons of water); or tobacco decoction (1 lb. in 2 gallons of water); or hongey oil or fishoil soap (1 lb in 4 gallons of water).

	Fruitfly (*Dacus dorsalis*, H.)	July to Aug. Nov. to Dec.	Hassan Chikmagalur Bangalore Tumkur Mysore Mandya	Grubs bore into the fruits and damage them	Same control measures as for Mango Fruitfly.
Coconut (*Cocos nucifera*)	Rhinocerous Beetle (*Oryctes rhinoceros*, L.)	Mar. to May	Mysore Hassan Bangalore Kolar Tumkur	Beetles bore into the growing shoot and damage the crown	Extract beetle from inside the palm with the help of a hooked wire; attract the adults to fermented toddy or castor-cake-residue exposed in shallow pans amidst the palms; dust Hexidole on manure heaps layer by layer alternating with each other.
Grape (*Vitis*, sp.)	Flea Beetle (*Scelodonta strigcollis*, M.)	May to June Sept. to Oct.	Bangalore Kolar Tumkur	Adults eat tender leaves	Dust Gammexane D. 025 with woodash (1 : 4) immediately the plants begin to put forth fresh flush; collect beetles on plants either by tapping them into a basinful of water with a thin film of kerosine oil or by means of handnets.
	Berry Borer (*Oxyptilus regulus*)	Nov. to Jan.	Bangalore Kolar Tumkur	Grubs bore into the fruits and cause rotting	Dust fruits with Pyrethrum or Derris powder and woodash (1 : 4).
	Stem Girdler (*Sthenias grisator*, F.)	Nov. to Jan.	Bangalore Kolar Tumkur	Grubs girdle round the stem and cause drying up of the plant	Handpick beetles during the season; Swab D.D.T. 550 paste on the stem during October-November as a protection against beetle attack.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Apple (*Pyrus malus*)	Weevil (*Myllocerus*, sp.)	Oct. to Dec.	Bangalore Kolar	Weevils eat the foliage	Dust Gemmexane D. 025; spray calcium arsenate if fruits are not set.
	Cockchafer	Mar. to Apr.	Bangalore Kolar	Beetles defoliate the plants	Collect beetles after dusk and destroy; spray calcium arsenate solution late in the evening if fruits are not set.
Fig (*Ficus*, Sp.)	Mite (*Eriophyes*, Sp.)	May to Oct.	Bangalore Kolar	Adults and nymphs suck the sap of the plants	Dust flowers of sulphur mixed with fine woodash (1 : 6); or spray dilute solution of lime sulphur.
Pomegranate (*Punica granatum*)	Caterpillar Borer (*Virachola isocrates*, F.)	Apr. to May	Tumkur Kolar Bangalore	Caterpillars bore into young and ripening fruits and destroy the fruits	Spray calcium arsenate with sugar added on newly-set fruits; cover developing fruits with a thin wire-gauze or muslin bag; remove badly-infested fruits and destroy them.
Castor (*Ricinus communis*)	Semilooper (*Achoea janata*, L.)	Aug. to Oct.	Bangalore Tumkur Chitaldrug Kolar	Caterpillars defoliate the plants	Spray lead or calcium arsenate; handpick caterpillars and pupæ and destroy; broadcast cooked rice to attract crows and other birds which eat the caterpillars.

	Cutworm (*Prodenia litura*, F.)	Aug. to Oct.	Bangalore Tumkur Chitaldrug Kolar	Caterpillars defoliate the plants	Same control measures as for Castor Semilooper.
	Pod Borer (*Dichocrocis punciferalis*, G.)	Sept. to Nov.	Bangalore Tumkur Chitaldrug Kolar	Caterpillars bore into the pods and feed on tender seeds	Spray pods with calcium arsenate; or dust with Gammexane D. 025 and woodash (1 : 4).
	Blackheaded Caterpillar (*Diacrisia obliqua*, W.)	Oct. to Dec.	Bangalore Tumkur Chitaldrug Kolar	Caterpillars defoliate the plants	Same control measures as for Blackheaded Caterpillar under Ragi.
Groundnut (*Arachis hypogea*)	Leaf-Mining Caterpillar (*Stomopteryx nerteria*, M.)	Sept. to Oct.	Shimoga Chitaldrug Tumkur Mysore Bangalore Kolar	Caterpillars mine the leaves and web	Dust Gammexane D. 025 and woodash (1 : 6) as soon as any leaves begin to curl up; set up light-traps at intervals to attract moths
Cotton (*Gossypium*, Sp.)	Spotted Bollworm (*Earias fabia*, S.: *Earias insulana*. B.)	June to Oct.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Caterpillars bore into tender twigs and developing bolls	Clip the tender withering and drooping twigs and destroy them; collect infested bolls and destroy them; dust Gammexane D. 025 on young and tender leaves and bolls; select healthy seeds for planting.
	Pink Bollworm (*Platyedra gossypiella*, S.)	Aug. to Oct.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Caterpillars bore into the bolls and damage them	Collect infested bolls and destroy them; dust Gammexane D. 025 on developing bolls; select healthy seeds for planting.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Cotton (*Gossipium*, Sp.)	Leaf-Roller (*Sylepta derogata*, F.)	Apr. to Aug.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Caterpillars feed on leaves and roll them	Dust Gammexane D. 025 on young plants when the first symptoms of rolled leaves are seen; in heavy infested areas remove all rolled leaves and destroy them.
	Red Bug (*Dysdercus cingulatus*, F.)	June to Sept.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Adults and nymphs damage the bolls and stain the lint within	Same control measures as for Pink Bollworm.
	Dusky Bug (*Oxycaroenus loetus*, K.)	June to Sept.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Adults and nymphs damage the bolls and stain the lint within	Same control measures as for Pink Bollworm.
	Stem Weevil (*Pempherulus affinis*, F.)	Nov. to Dec.	Mysore (T. Narasipur and Melkote)	Grubs bore into seedlings just at ground level, form galls and destroy the seedlings	Earth up along the rows of seedlings at least twice in the early part of season; remove affected plants and seedlings and destroy them.
	Stem Beetle (*Sphenoptera gossypii*, K.)	Sept. to Nov.	Mysore Bangalore Chitaldrug	Grub bores into the stem and causes wilting	Prune twigs showing wilting and destroy them.

	Aphis (*Aphis gossypii*, G.)	May to Aug.	Chitaldrug Mysore Hassan Chikmagalur Bangalore	Adults and nymphs suck the sap of tender portions of plants	Spray hongey oil soap or fish oil soap (1 lb. in 8 gallons of water) or tobacco decoction; dust tobacco powder and woodash (1 :4).
Coffee (*Coffeea arabica* and *robusta*)	Stem Borer (*Xylotrechus quadripes*, Chevr.)	Sept. to Dec. Apr. to May	Chikmagalur Hassan	Grubs bore into the stems of Arabica coffee and kill the plants	Regulate shade so as not to leave open and sunny patches; scrub the stems of plants smooth at least once in 2 years; uproot and burn infested plants during the breeding seasons of the pest; swab the stems with 10% wood- or coal-tar emulsion during the major breeding season of the beetle; Handpick beetles and destroy them.
	Shot-Hole Borer (*Xyleborus morstatti*, Hagd.)	May to July Oct. to Nov.	Chikmagalur Hassan	Grubs bore into slender twigs of Robusta coffee and causes them to dry and wither	Prune regularly infested and withering branches twice a year, during summer and autumn months; avoid heavy shade.
	Scale Insects and Mealy Bugs	May to July Oct. to Nov.	Chikmagalur Hassan	Insects suck the sap of tender twigs and leaves	Spray hongey oil soap or fish oil soap (1 lb. in 5 gallons of water) during the seasons the pests occur; collect leaves with fungus-attacked insects (white fungus in south-west and black fungus in north-east monsoons) and disperse them in areas where only the pest is seen; destroy all nests of ants in the neighbourhood of estates.

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Coffee (*Coffeea arabica*)	Berry Borer (*Aroecerus fasciculatus*, Deg.)	Dec. to Mar.	Chikmagalur Hassan	Adults and grubs damage green and ripe berries in the field and also dried berries in the store	Collect and destroy all damaged berries; dry the seeds well before storing; fumigate seeds in the store with a mixture of ethylene dichloride and carbontetrachloride (3 : 1) at the rate of 30 lbs. per 1,000 c.ft.
	Wingless Grasshopper	Dec. to Apr.	Chikmagalur Hassan	Adults and nymphs defoliate the plants	Collect hoppers with handnets.
	Winged Grasshopper (*Aularches miliaris*, D.)	Jan. to Mar.	Chikmagalur Hassan	Adults and nymphs defoliate the plants	Collect hoppers with handnets.
Cardamom (*Elettaria cardamomum*)	Thrips (*Taeniothrips cardamomi*, R.)	Feb. to Oct.	Chikmagalur Hassan	Adults and nymphs suck the sap of flowers and capsules causing itch-like markings	Spray the fruit spikes and bases of leaf sheaths with a mixture of tobacco decoction and hongey oil soap at least once a fortnight from the time green pods are formed till the fruits are ripened.
	Hairy Caterpillar (*Eupterote canariaica*, M.)	Nov. to Dec.	Chikmagalur Hassan	Caterpillar feeds on foliage	Collect and destroy all pupæ found beneath the plants and near vicinity; collect and disperse fungal-attacked caterpillars in areas where the caterpillars are found in numbers.

Tobacco (*Nicotiana tabacum*)	Aphis (*Myzus persicae*, S.)	June to Oct.	Bangalore Kolar Mandya Mysore Tumkur Chitaldrug	Adults and nymphs suck the sap of leaves	Spray hongey oil soap or fish oil soap (1 lb. in 8 gallons of water) or tobacco decoction.
	Stem Borer (*Phthorimoea heliopa*, L.)	May to Oct.	Bangalore Kolar Mandya Mysore Tumkur Chitaldrug	Caterpillars bore into seedlings and stems of plants forming galls	Cover up nursery with thin cloth and water over the cloth; dip the seedlings in a solution of calcium arsenate before transplanting; remove borer from inside the galls in stems by means of a knife.
	Cutworm (*Prodenia litura*, F.)	Nov. to Jan.	Bangalore Kolar Mandya Mysore Tumkur Chitaldrug	Caterpillars eat the leaves and cause damage	Disperse poison-bait; spray nursery with calcium arsenate.
Mulberry	Grasshopper (*Orthacris*, Sp.)	Nov. to Feb.	Mysore	Hoppers and nymphs feed on foliage	Collect hoppers with handnets.
Stored Grains	Rice Weevil (*Calandra oryzae*, L.) Lesser Grain Borer (*Rhizopertha dominica*, F.) Flour Beetles (*Tribolium*, sp.)	Throughout the year	Throughout the State	Cause damage to stored grains	Practise clean godown sanitation; fumigate infested grains with 'killoptera'; treat grains for seed purposes with Gammexane D. 034 (1 oz. to 100 seers of grain); top-dress the stored grains in bins with 1" thick layer of sand to prevent fresh infestation; or expose small quantities of metal mercury amidst and on top of heap of grain; or treat

Name of Crop	Name of Insect Pest	Period of Occurrence	Distribution (Districtwar)	Nature of Damage	Control
Stored Grains	Long-Headed Flour Beetle (*Latheticus oryzae*, W.)				grains with paddy husk ash to kill the insects already present and to keep the grains free from further infestation by insect pests.
	Saw-Toothed Beetle (*Oryzaephilus (Silvanus) surinamensis*, L.)				
	Khapra (*Trogoderma khapra (granaria), Arr.*				
	Flat Grain Beetle (*Laemophlaeus minutus*, Ol.)				
	Pulse Beetles (*Bruchus*, sp.)				
	Augonmois Grain Moth or Paddy Moth (*Sitotroga cerealella*, Ol.)				
	Rice Moth (*Corcyra cephalonica*, St.)				

PRACTICAL HINTS TO AGRICULTURISTS

1. *Light Trap.*—A simple light trap can be devised by keeping a petromax lamp, at crop level, in a basin half full of water with a thin film of kerosine oil on the surface of water. The lamp may be rested on bricks inside the basin. To increase the efficiency of the trap, a shade over the top of the lamp to avoid scattering of light may be provided. The light trap may be generally installed in the fields at about 8 p.m. or later in the night.

2. *Flooding the Field with Water with a Thin Film of Kerosine Oil.*—This is accomplished by keeping a gunny rag dipped in kerosine oil at the inlet of water into field. Prior to leading water into the field, all the outlets should be blocked. Later the field may be flooded with water when a thin film of kerosine oil also spreads on the surface of water. The water should be allowed to stand for about 2 to 3 hours and drained to the next field. By keeping another piece of gunny rag dipped in kerosine oil the same water may be used for a larger area in the same stretch of infested field.

3. *Poison Bait*: (*a*) *Fruit Flies.*—Citronella oil + sugar + calcium arsenate is made into a thin solution and is put in an empty cigarette tin through the cover of which pass several small vicks. The tin is inverted and hung from the branches of trees allowing the bait solution to drip drop by drop. Flies are attracted to the solution and feed on the poisoned sugar syrup.

(*b*) *Cut Worms.*—The bait is made by mixing 1 lb. of sodium silico fluoride with 8 lb. of bran and 2 lb. of jaggery. This mixture is dispersed in the fields, where the insect damage is seen, late in the evening.

(*c*) *Grasshoppers.*—The bait is prepared by mixing 1 lb. of sodium silico fluoride with 4 lb. of bran and 1 lb. of molasses. A small quantity of amyl acetate is added to this mixture. The bait is broadcast in the field late in the evening.

4. *Calcium Arsenate Solution.*—1 lb. of calcium arsenate is put in 2 gallons of water and stirred well. 2 lb. of lime is dissolved in 2 gallons of water and strained. 3 lb. of jaggery is dissolved in 3 gallons of water. Lime-water and jaggery solution is first mixed and later the calcium arsenate suspension solution is mixed and the whole mixture is stirred well. The mixture is made up to 50 gallons of solution by adding the required quantity of water. This spray mixture is ready for use. The spray mixture should be kept well-stirred even during spraying.

(*Caution.*—Copper vessels should not be used. During spraying beetle leaves or any other foodstuff should not be eaten or taken. Hands should be thoroughly washed with plenty of soap after spraying. Containers used for preparing the spray mixture should be thoroughly washed with plenty of water immediately after spraying.)

5. *Tobacco Decoction Spray.*—1 lb. of dried tobacco leaf is steeped in 1½ gallons of water for 12 to 24 hours. Later the leaves are squeezed and resultant decoction is strained. 1/8 lb. of Hongey oil or washing soap is dissolved in ¼ gallon of water separately. The two solutions are mixed and stirred well and the spray mixture is made up to form the required strength. (Usually, unless otherwise mentioned, the spray mixture is made up to 3 gallons.)

6. *Fumigation with "Killoptera".*—The doors and windows of the room in which fumigation is to be conducted should be well sealed with wet earth. Only one-half of the door should be kept open prior to fumigation. The material to be fumigated should be arranged in a definite manner loosely. The chemical is then poured on the grains or other materials except 'flours', or kept in shallow pans on top of the material in several places, if the heap is big. Chemical, at the rate of 30 lb. per 1,000 c.ft., should be used. Great care should be taken to see that no one is allowed inside the room. Immediately after pouring out the chemical, the half door is closed and sealed with wet earth. The door should be opened about 48 hours after the room is sealed. Immediately when the room is opened none should enter the room but allow sufficient interval before any one desires to enter the room. The windows and doors of the room should be opened before any observation is made on the treated grains. Later the material should be aerated for at least about 24 hours or till such time that no trace of smell of the chemical is felt. It is always better to conduct fumigation with the help of a trained departmental staff to avoid any small errors that may arise.

7. *Clean Godown Sanitation.*—(*a*) The godown should be well ventilated. (*b*) The bags containing grains or other materials should be arranged tier above tier, the bottom layer being placed on bamboo props allowing enough space (about 1½′ to 2′) all round alongside the wall and beneath for sweeping. (*c*) The godown should be swept daily and the sweepings collected, sieved and kept separate. (*d*) The bags should be removed from the godown in the same order in which they were received, thus avoiding the usual mistake of keeping certain early-received bags for unduly long time. (*e*) Godown spray (Pyrethrum extract in Kerosine oil) should be sprayed on the walls and bags at least once in 7 to 10 days. Certain chemicals like Gammexane D. 024 or D.D.T. 10% may be spread in the form of band

(about 3" wide) around the heap of grains or bags; but great care should be taken to see that the chemicals do not come into direct contact with grain. (*f*) As far as possible only well-dried and healthy grains should be kept in the godowns and infested grains should not be mixed with healthy grains.

SUBSIDIARY FOODS

A RADIO TALK

By *Rajasevasakta* A. K. Yegna Narayan Aiyer
Retd. Director of Agriculture

From the A.I.R., Mysore, on 12-2-1951.

(*By kind permission of the Station Director*)

The acute shortage of food grains which this country has been experiencing for the last seven years, and the remedial measures taken by the Government are extraordinary in many respects. India has had many famines in the past, some of them unsurpassed in their vastness and severity, but none has lasted so many years nor prevailed so universally through the length and breadth of the land. Moreover, the shortage continues in spite of the stupendous annual imports of all kinds of grains from every possible country in the world, and of the strenuous attempts at increasing home production. And yet the supplies are only going down if we may judge from the steadily diminishing quantity rationed out, nor are there indications that we can carry on without outside help in the immediate future. As regards remedial measures, while in the past, Government has tried to fight famines by the opening of famine camps and carrying relief only to the needy and the destitute, in the present case Government has taken upon itself the duty of feeding everyone, a truly superhuman task. This measure of giving each one his daily bread across a ration shop counter has landed Government in an impossible situation, the task being found more and more difficult on the one hand, and the system itself once initiated impossible to abandon without risk of serious consequences, on the other. The only way out of this baffling dilemma is increased production, which will give us an assured and adequate supply for both the present and for many years in the future as well. The vast schemes of land reclamation and settlement, the numerous irrigation projects, both large and small, for harnessing not only surface water but also underground sources, the fertiliser factories and other projects which are all under way will, when they come into fruition, benefit untold generations and it is of the utmost importance that they should be speeded up. Where, we may ask meanwhile, does the role of subsidiary foods come in, in this gigantic set-up? This, one must admit, can but be small, but a knowledge of what they are and how they can be used will help the

public to eke out their meagre ration; may relieve the pressure on the demand for cereals to some extent and may even stimulate research leading to a permanent increase in our food resources. At any rate, every little helps in these difficult times and this is the reason I have ventured to give this talk.

What are these so-called subsidiary foods? They are, as the name implies, distinguished from the staple foods, and comprise those which can supplement or even partially substitute the staple foods. They are generally less difficult of cultivation and imply a somewhat unused abundance being consumed only to a smaller extent. Although it is chiefly as suppliers of the starch, carbohydrate, energy or heat-producing components of foods, and especially as a supplement to, or substitute for, rice that they have been familiarised, they may include complete foods as well and also those that make up deficiencies of particular components. I shall deal with all of them briefly.

Among such starch-supplying subsidiary foods, the most notable are the many edible roots or tubers, *i.e.*, the underground swollen stems and roots in which some plants store up starch and which man raids. Examples are potatoes, sweet potatoes, tapioca and many others to which I shall refer, presently. *The tapioca* is by far the richest among them, with a starch-content of some 38 per cent. Having been introduced over a century ago into Travancore by one of its far-seeing Maharajas, it is there that the crop is grown extensively at present. It is a 10 to 12 months crop, and yields abundantly, requiring a high rainfall or moderate irrigation. The roots contain a certain amount of the poison prussic acid and can be eaten only after being boiled. It can be eaten like a boiled vegetable, or dried and ground and made into a flour or meal. In either form it can very materially supplement rice. The flour, however, has industrial uses and as sizing material is in great demand in the textile mills, which are formidable competitors with it as a food.

The sweet potato comes next with a 31 per cent. starch-content; its use is safe and well known. It is a much satisfying food and is often the poor man's standby during famines. Its cultivation and use deserve to be increased.

The potato is really the king of tuber crops; it gives a crop in 90 days, two crops can be grown in the year, with a third crop of short-season ragi or maize in addition under intensive cultivation. Though grown only on the hills and plateaux, it can be grown on the plains also in the cold weather. Its starch-content is about 25 per cent., but a single crop may yield up to five tons of the tuber.

The yams like the elephant yam, "Surangadde" (*Amorphophallus companulatus*) and the colocassias like *C. antiquorum* ("Samegadde")

are well-known edible roots which yield abundantly and are in general use.

The roots of the *Dioscoreas* attain remarkable sizes, of even 25 lb. and in one species, *viz.*, *D. alata* is said to have reached 85 lb. It may not be generally known that attempts were made some fifty years ago to popularise West Indian varieties in India by one Mr. Mitchell in Calcutta. Though this has not caught on, many local varieties are already under cultivation and are common vegetables; these are the species, *alata, globosa, purpurea,* and *sativa.*

Coleus parviflorus yields an excellent tuber in abundance and deserves to be cultivated largely.

The fruit called *Singara nut* (*Trapa bispinosa*) is a great standby in Kashmir, Bengal and Bihar. It is an aquatic plant and many tanks and lakes can be used for growing it; it does not therefore compete for land with other crops. In Kashmir it is reported to furnish food for five months in the year to 30,000 people and that one lake alone, the Wulur Lake, yields 100,000 ass loads of the nut per year. It is a six months' crop with a starch-content of 25 per cent., and is eaten boiled, popped, or roasted and ground. It is eminently worthy of introduction in other parts of the country as well.

The arrow-root which grows both wild and is also cultivated to some extent, both in the West Coast and in the Orissa State, yields an excellent and well-known flour, estimated at about 13 per cent. on the weight of the fresh roots, while the edible cannas more or less come in the same class.

The seed of the jack fruits comes in a separate class; it is almost a bye-product, but has nearly 40 per cent. starch. It can keep, so can be had both in the jack season and out of it. It can be eaten toasted, boiled or made into flour.

The cooking plantains and dessert plantains are other good sources of starchy (or sugar) foods, and are too well known to be described.

The papaya fruit holds great possibilities; it yields abundantly, the green fruit can be used as a vegetable while the ripe fruit is as satisfying as a meal. In one's and two's every household can grow it and make a substantial addition to its food supply.

The seeds of the Amaranthus paniculatus (Kannada: "Rajakire" or "Horigire) afford a rich source of starch and are eaten fried or popped. One story goes that it was the means of saving many lives in one of the famines in Mysore. It grows wild and is also cultivated to a small extent, but deserves to be extended.

Buckwheat (which is not a cereal) is another crop worthy of larger cultivation. It is a ninety-day crop, can thrive on rough poor soils and at present have some vogue in Northern India. The flour is

a highly esteemed food, considered more nourishing than many cereals, and may amount to half the weight of the seed. The seed has however to be broken and the seed-coat removed to get at the flour.

The next group comprises *the grains and pulses* themselves, which can, in one sense, be called "subsidiary" also, and constitute far and away the most important group. Where rice or ragi is the staple, for example, wheat and the other grains become subsidiary and *vice versa.* It is possible for reasons I cannot go into here that a diet of more than one cereal is better than one confined to a single cereal, and these subsidiary foods may, therefore, be found to play a very important role. The pulses have the distinguishing merit of being protein foods besides containing large quantities of starch, so that they furnish both components. They may be available in plenty when rice may not, and hence may be used to make up the deficiency. The vogue of eating fried and salted pulses, including groundnuts, as a snack is to be welcomed. Groundnuts are indeed weight for weight about 50 per cent. more energy-supplying than rice.

All the foods listed so far can be prepared into a number of dishes and this opens out a wide field for the exercise of the culinary talent of our women folk, some of whom are wizards in the art and can work wonders with them. I have heard people whose staple food comprises the so-called inferior grains, bajra, jola, ragi and other dryland cereals, boast that they can prepare everyone of your familiar rice dishes, the *dosais, iddalies,* etc., with these cereals. I can personally testify to the excellence of some of them. What is wanted is a big demonstration drive, in which all the hotels and restaurants should actively co-operate.

I must, however, deprecate the processing or camouflaging of the staple foods, into the so-called synthetic grains, patent foods, alimentary pastes and powders and so on. It will be easy enough to prepare balanced and fortified mixtures, of this kind, but in doing so the grains lose their identity and this will straightaway open the door to all kinds of adulteration in unscrupulous hands, besides converting good and much sought-after food into forms of doubtful merit, which certainly will have to be forced on people. It is a great safety that in our country rice and other grains are bought and sold as such and not as flour or bread.

The so-called famine foods come in another class; they are eaten only when sheer hunger drives people to do so. Many years ago a collection of fifty odd articles of this kind, which I need not enumerate here, was sent up for analysis, which it fell to my lot to conduct. I mention this only to show that research may be able to render many of them more suitable as food.

I now come to the next group, *viz.*, animal food. The most important among them is fish. With its enormous sea-board and fresh-water lakes and rivers, India's resources in fish are almost inexhaustible. The Royal Commission on Indian Agriculture stressed the importance of fish food in a country where rice is the staple, and strongly recommended its development. Fish is indeed the food which has helped Japan to maintain a dense population on the minimum of rice land. Little has however been achieved, despite some ambitious deep sea fishing schemes. A vast permanent source of food thus remains untapped.

The next is poultry, eggs and I may add pigs, if my listeners will bear with me. These are means of converting the bye-products and waste materials of the farm and the home into valuable human food, and deserve utilisation to the full. Wartime food production in Great Britain centred much round these products and the methods are worth copying. It is peculiar that in India agriculture is associated in the public mind with crop production alone, whereas, a farmer raises not only crops but produces milk, poultry and eggs, rears a few sheep, fattens a pig or two and if conditions permit goes out with a gun after game, as is done by our neighbours in Coorg, or with net and spear, with a village party as in Mysore.

We have practically unlimited resources in food, but they need developing, and as far as these subsidiary foods are concerned, what is required is a good deal of propaganda on the part of the Government as indicated and a spirit of responsive co-operation on the part of the public.

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